


# THE PHOTONICS DICTIONARY™

1996 BOOK 4

## PHOTONICS



"The technology of generating and harnessing light and other forms of radiant energy whose quantum unit is the photon. The range of applications of photonics extends from energy generation to detection to communications and information processing."

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**An International Reference Work**

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**Glan Spectrophotometer.** A device similar to the ordinary spectrophotometer, but containing particular modifications to provide for the comparison of two sources.

**Glan-Thompson Prism.** A prism resembling a Nicol prism but having faces normal to the axis and the two parts divided by a glycerine film. Also known as Glan prism.

**Glass.** A noncrystalline, inorganic mixture of various metallic oxides fused by heating with glassifiers such as silica, or boric or phosphoric oxides. Common window or bottle glass is a mixture of soda, lime, and sand, melted and cast, rolled or blown to shape. Most glasses are transparent in the visible spectrum and up to about 2.5  $\mu\text{m}$  in the infrared, but some are opaque such as natural obsidian; these are, nevertheless, useful as mirror blanks. Traces of some elements such as cobalt, copper and gold are capable of producing a strong coloration in glass. Laser glass contains a small amount of didymium oxide. Opal glass is opaque and white, with the property of diffusing light. Some opal glass has a thin layer of opal material flashed onto the surface of ordinary glass. Tempered glass has a high degree of internal strain, caused by rapid cooling, which gives it increased mechanical strength.

**Glass Annealing Furnace.** A furnace, generally electrically heated, with a control system capable of following a cam by which the temperature can be made to go through a definite cycle over a period of days, or even weeks, if the glass is massive. Glass has a softening temperature above which it can be easily bent or molded to shape, and an annealing temperature below which the properties of the glass remain fixed down to room temperature. Between these two points is the annealing range in which it is essential to cool the glass very slowly to remove all strain and to drive the refractive index up to its stable maximum value.

**Glass Barium (Baryta).** A type of glass containing barium oxide, which is added to increase the refractive index while maintaining a relatively low dispersion.

**Glass Capacitor.** A capacitor that uses glass as its dielectric material.

**Glass-Ceramic.** A type of glass used in telescope mirrors, formed by adding a nucleating agent to standard glass and then heating it until it crystallizes.

**Glass Dosimeter.** A device that detects and measures the quantity of exposure to nuclear radiation. It uses a special glass rod that fluoresces when placed under ultraviolet radiation after its exposure to nuclear radiation.

**Glass Film Plates.** Early form of photographic media consisting of glass plates coated with an emulsion.

**Glass Laser.** Optically pumped solid-state laser in which the active medium is a neodymium ion in a glass rod host. Abbreviated Nd:glass.

**Glass Marking Ink.** Ink used for writing on glass, and also for blackening the edges of lenses to prevent reflection. In the latter case the refractive index of the ink must closely match that of the glass.

**Glass Melting Furnace.** A furnace used to heat glass materials. It may be a small laboratory-type furnace for small-scale experiments, or may be large enough to hold gas-fired tanks for the commercial mass production of glass. Special types of optical glass are often made in 20-lb platinum pots, but the more common types are produced in ceramic or platinum-lined tanks. The raw materials are fed into one end and the molten glass withdrawn from the other end in a continuous fashion.

**Glass Spectrograph.** A spectrograph having glass as its refracting component and used in cases where speed and high dispersion are not required. The glass material has a range of about 3700 to 8000  $\text{\AA}$ .

**Glazing.** The process whereby a spectacle lens is placed in a frame.

**Glide Plane.** The plane shared by the pair of axes in a twin crystal.

**Glitter.** The specular reflection of individual parts of a surface.

**Global Optimization.** A controlled random search process, such as generalized simulated annealing, that has been incorporated into many optical design programs as a way of helping designers find the most suitable lens configuration.

**Global Radiation.** The total radiation, both solar and diffuse sky, that is incident to a unit's horizontal surface.

**Globar.** A light source made up of silicon carbide or

carborundum. It is resistant to the negative temperature coefficient and mechanical distortion.

**Globulite.** A crystal of microscopic size having no definite plane faces and having a globular shape. At the time the crystal is formed, the strong surface tension influences the formation of the plane faces.

**Gloss.** Property of a surface which, due to directional reflection, is responsible for the degree to which reflected highlights or the images of objects may be seen as superimposed on the surface.

**Glossmeter.** An instrument for measuring gloss by comparing the specular reflectance to that from a perfect specular reflector.

**Glow Discharge.** An electric discharge in a low-pressure gas having a low-current density and a space potential near the cathode that is much higher than the ionization potential of the gas, but less than its sparking potential.

**Glow Lamp.** A lamp in which the ionization of the inert gas contained in it produces a glow in the space close to the negative electrode.

**Golay Cell.** A thermal radiation detector consisting of a small cell with a blackened plastic front face which bulges slightly when heat is received by it. The bulging tilts a small mirror, which, in its turn, varies the amount of light proceeding from a lamp to a photocell. The radiation is measured by sensing the increase in pressure in a gas chamber as the temperature rises when radiation is absorbed.

**Goldberg Wedge.** A neutral colored gelatin wedge, cast between glass plates, that is used as an intensity scale in certain types of sensitometers; the greater the thickness of the wedge through which light emitted by a source is transmitted, the stronger the intensity of the source.

**Gold Vapor Laser.** See Metal Vapor Laser.

**Goniometer.** A spectrometer or autocollimator used to measure prism angles.

**Goniometer Eyepiece.** An eyepiece having a rotating index or cross wire linked to an external 360° scale to allow measuring of angles in an image.

**Goniometer.** A device used to measure directional reflectance, with light collection restricted to a narrow range of angles of which the central angle varies.

**Goniophotometric Curve.** The graphed curve illustrating the directional reflectance of a sample for different angles of collection.

**Government Open Systems Interconnection Profile (GOSIP).** A set of specifications for all communications network products purchased by the federal government, effective August 15, 1990.

**Graded-Index.** Descriptive of an optical fiber having a core refractive index that decreases almost parabolically and radially outward toward the cladding. This type of fiber combines high bandwidth with moderately high coupling efficiency. Sometimes called graded-index.

**Graded Reflectivity Mirror.** A mirror whose percent reflectance varies as a function of position on the mirror surface.

**Gradient.** In image processing and machine vision, rate of change of pixel intensity.

**Gradient Edge Enhancement.** Edge enhancement with a directional characteristic.

**Gradient Index (GRIN) Lens.** A lens whose material refractive index varies continuously as a function of spatial coordinates in the medium. See Axial Gradient; Radial Gradient; Spherical Gradient.

**Gradient Vector.** In an image, the orientation and magnitude of the rate of change in intensity at any point.

**Graded Refractive Index.** See Graded-Index.

**Grain Isolating Diaphragm.** In a microscope, the diaphragm that is located between the Bertrand lens and the eyepiece, and that is closed during conoscopic viewing to restrict the interference figures to that of a crystal lying on the optical axis of the microscope.

**Gram.** Unit of mass in the SI system.

**Graphicon.** An electron tube having two electron guns, one on each side of the storage medium, to encode the information onto the medium, and to read and simultaneously erase the electrostatic encoding.

**Graphic Arts.** All methods of reproduction and printing in photomechanical systems.

**Graphic Arts Camera.** A large camera on a horizontal bed, the

easel for holding the copy and the lens being movable to change the image magnification. The sensitive plate or film is often placed within the dark room for immediate processing.

**Graphic Arts Equipment.** The large process cameras and associated equipment used to prepare halftone printing plates in color or monochrome from a given picture.

**Graser.** An acronym of gamma ray amplification by stimulated emission of radiation. A graser is a gamma ray laser that operates between energy levels established by metastable isomeric transitions in the nucleus.

**Grashof Number.** Formula used in convection study to express the ratio of buoyant force to viscous force.

**Graticule.** The British term for reticle.

**Grating.** A framework or latticework having an even arrangement of rods, or any other long narrow objects with interstices between them, used to disperse light or other radiation by interference between wave trains from the interstices. The ability of a grating to separate wavelengths, (chromatic resolving power) is expressed as being equal to the number of lines in the grating.

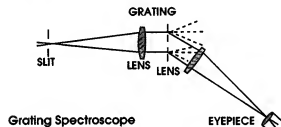
**Grating Monochromator.** An optical instrument used to isolate a narrow bandwidth of optical radiation using a diffraction grating as the dispersive element. (See also Monochromator.)

**Grating Prism.** A specific, right-angle prism having a transmission grating replicated on its hypotenuse face and used in applications requiring a system that can produce in-line viewing for one wavelength.

**Grating Spectrophotometer.** See Spectrophotometer.

**Grating Spectrometer.** A spectrometer that uses a grating to diffract light into specific wavelengths.

**Grating Spectroscope.** A spectroscopic device having a diffraction grating for the resolution of light of various wavelengths.



**Grating Substrate.** The substrate upon which a diffraction grating will be ruled. It must be dimensionally stable, and the surface must be polished to an accurate flat or spherical form as required by the grating. The substrate for a replica must have the identical but opposite form to the original substrate. For a reflecting grating the substrate need not be transparent, but for a transmission grating it must be transparent.

**Gravimeter.** An instrument capable of precise measurements of the earth's gravity. This permits the detection of small changes in local height which indicate changes in the earth's crust and subsurface density.

**Gravitational Imaging.** A process used to detect minute gravitational fields and to display images from objects by means of radiated gravitational imagery.

**Gravitational Waves.** Postulated by Einstein in his theory of relativity. They are waves traveling at the speed of light and exerting force on matter in their path. They are produced by changes in the distribution of matter.

**Gray.** 1. A measure of absorbed dose, equal to the energy imparted by ionizing radiation to a mass of matter corresponding to one Joule per kilogram. 2. A term used to denote an incompletely polished surface that shows a graininess arising from the remains of fine grinding.

**Gray Body.** A temperature radiator whose spectral emissivity at all wavelengths is in constant ratio (less than unity) to that of a complete radiator at the same temperature.

**Gray Filter.** See Neutral Density Filter.

**Gray Levels.** In image processing, machine vision and television, discrete brightness values quantized for a group of pixels. They can range from white, through various shades of gray, to black.

**Gray Scale.** In image processing, the range of available gray

levels. In an 8-bit system, the gray scale contains values from 0 to 255.

**Gray-Scale Image.** An image consisting of an array of pixels that can have more than two values (black and white). Typically, up to sixteen levels are possible per pixel.

**Gray-Scale Modification.** Image enhancement operations that involve altering gray-scale values. For instance, brightness sliding involves adding or subtracting an identical brightness value to or from each pixel in an image; contrast stretching involves dividing or multiplying all pixels by an identical brightness value.

**Gray Scales.** Transparencies that represent progressive steps in the amount of transmitted radiation for administering predetermined amounts of radiation to a radiation-sensitive substance. The steps are customarily calibrated in transmissivity (the ratio between transmitted and incident light), opacity (the inverse of transmissivity), or density (which is the log to base 10 of opacity). Thus, a step differs from its neighbor by increments — a density of 0.3 transmits about half of the incident light; a density of 1.0, about one-tenth; 2.00, about one-hundredth; 3.00, about one-thousandth.

**Grazing Emergence.** A condition in which an emergent ray is perpendicular to the normal of the emergent surface of a medium.

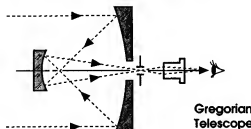
**Grazing Incidence.** Light striking a surface at an angle almost perpendicular to the normal.

**Green Block.** A porous ceramic substance that is ground to a given optical form and on which a polished plate of glass is saggered by heat application. It is capable of transmitting in a partial vacuum. The glass contacts the green block surface by the applied vacuum and gravitation, and the upper polished glass surface is used as an optical surface. Green block is generally used to produce aspheric surfaces of medium precision.

**Green Disk.** A familiar term for CD/1 disk. The CD/1 standard is also known as the green standard.

**Greenough Microscope.** A form of stereoscopic microscope having paired objectives, prisms, and eyepieces, invented by H. Greenough.

**Gregorian Telescope.** A telescope with an ellipsoidal secondary concave mirror that reflects rays from a parabolic primary mirror back through an opening in the center of the primary where the image is viewed with an eyepiece. Gregorian telescopes are very popular, because they give an erect image and are thus suitable for terrestrial observations.



**Grenz Rays.** The soft x-rays used in the industrial radiography of materials having too small a range of densities to produce an image with normal x-rays.

**Grinding.** The process in the manufacture of an optical system that gives it the required geometric shape.

**Grinding and Polishing Machinery.** Machinery used to grind and finish a component, such as a lens or prism, to a desired precision. Usually such machines carry a cup-shaped or flat tool (lap) into close contact with the part. An abrasive or polishing material is placed between the tool and the part, and the lap is moved in a nonrepetitive series of movements. Driving mechanisms for aspheric shaping are complicated; for spherical and flat parts they are relatively simple.

**Grinding Tool.** A tool of cast iron or another suitable medium used with a slurry of silicon carbide, aluminum oxide, or emery for grinding optical surfaces.

**Griffting Test.** A method of determining the abrasion resistance of very hard materials by passing a weighted wiper blade across them in a sand-water slurry for a specified number of times.